Fundamentals of Strength Acquisition for Combat Sports

On January 11, 1994, a well known boxing commentator stated to his television audience that he felt weight training was counter-productive to fighters, adding "muscle weighs more than fat." This amusing statement reveals much about the enduring stigma associated with strength development in boxing and martial arts circles. Of course, strength determines how much speed, power, agility, stamina, and technical ability any athlete can develop, and combat athletes are no exception.
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Strength Defined

Strength can be loosely defined as the ability to apply musculo-skeletal force. But for a more precise definition, we must first consider the various types of strength expression available to athletes.

The Many Faces of Strength

Strength as a bio-motor ability has many expressions. Since all motor tasks require force production, all athletes must concern themselves with developing their strength levels to the utmost. The following list highlights the various types of strength needed by athletes involved in combat sports.

Maximal Strength

Maximal strength (also called absolute strength) is defined as the amount of musculoskeletal force you can generate for one all-out effort. Maximal strength can only be demonstrated or tested in the weight room during the performance of a maximum (1RM) lift. While only powerlifters need to demonstrate this type of strength under competitive conditions, martial artists need to develop high levels of maximal strength as a "foundation" for subsequent training objectives later in the training cycle.

Relative Strength

Whereas maximal strength refers to strength irrespective of bodyweight, relative strength is a term used to denote an athlete's strength per unit of bodyweight. It can be used as a modifier for other categories of strength, such as speed strength or strength endurance. Thus if two athletes of different bodyweights can squat 275 pounds, they have equal maximal strength for that lift, but the lighter athlete has greater relative strength. Similarly, if two athletes of different bodyweights have a vertical jump of 30 inches, they have equal absolute speed-strength, but the lighter athlete has greater relative speed-strength

Sports which have weight classes depend heavily on relative strength, as do events where the athlete must overcome his or her bodyweight to accomplish a motor task (i.e., martial arts, long jump, sprinting, etc.).Further, sports which have aesthetic requirements (figure skating, gymnastics, and forms competition in martial arts) rely heavily upon the development of strength without a commensurate gain in bodyweight.

Methods of Strength Development

Strength can be developed either by applying stress to the muscle cells themselves, or by targeting the nervous system. The former method is accomplished through "bodybuilding" methods (repetitions between 6 and 12), and results in strength gains through an increase in muscle cross-section. The latter is accomplished through higher intensity training (repetitions between 1 and 5), where increased strength is the result of improved "intra-muscular coordination" (the ability to recruit a greater percentage of the existing motor unit pool).

Athletes who need absolute strength (throwers, football linemen, etc.) may utilize both methods. First, bodybuilding methods are used, followed by nervous system training. The result is an increase in bodyweight and absolute strength. However, as bodyweight increases, relative strength decreases. Athletes who depend upon relative strength should use bodybuilding methods sparingly, unless a higher weight class is desired. Most strength training is characterized by high intensity (meaning, a high percentage of the athlete's 1RM), low repetition sets, which improve strength through neural adaptations rather than increases in muscle cross section.

The Stretch-shortening Cycle (SSC)

Most human movement is characterized by an eccentric phase immediately followed by a concentric phase. This muscular action is called the stretch-shortening cycle, or SSC. Examples include throwing, jumping, and even walking. During the eccentric phase, the tendons develop and store potential kinetic energy, similar to a stretched elastic band. During the concentric phase, this potential kinetic energy is returned, resulting in greater force output than if the movement had begun concentrically. In some movements (jumping rope, for example), the muscle contracts statically, with movement being provided by the storing and release of elastic energy through the tendons. Since static muscular activity requires less energy than concentric activity, the SSC is an "economical" way of producing force.

The efficiency of the SSC is easily demonstrated: Perform a vertical jump in a normal manner, where you first crouch, and then jump upwards as explosively as possible. Next, crouch, but pause for five seconds, and then jump upward. You'll see that the jump where the crouch (or eccentric phase) was IMMEDIATELY followed by the jump was more successful. The key to preserving as much potential kinetic energy as possible is to switch from eccentric to concentric as rapidly as possible. This switch is termed "reactive strength" by some authors.

If you view a videotaped sparring match in slow motion, you'll see that almost all fighters "cock" their punches, be it ever so slightly. The best fighters manage to minimize this preparatory movement, because observant opponents can pick up on it. (note: sometimes, physical preparation methods must defer to tactical requirements).

In order to respect the principle of specificity, strength training methods should reflect the SSC nature of athletic skills. The best form of resistance training technologies to accomplish this task are constant resistance, or "free weights," and variable resistance, which utilize either cams or levers, in an attempt to "match" the resistance to the strength curve of the muscle being trained. The former technology is preferred, at least in the case of advanced athletes, because machines tend to rob the synergists and stabilizers of adaptive stress.

Rate of Force Development
For combat athletes, maximal strength is a means rather than an end. In most athletic endeavors, the time available to develop maximum muscular force is extremely limited- usually only a fraction of a second. While high levels of maximal strength are a necessary prerequisite for the development of speed strength, too much time spent lifting heavy weights at slow speeds, without progressing to speed strength methods later in the training cycle, results in slow athletes.

The ability to apply muscular force rapidly is called rate of force development, or RFD. Bodybuilding methods slightly improve maximal strength, but have a negligible effect on RFD. Training with heavy weights will improve absolute strength, but again, the RFD remains largely unchanged. Only when speed strength methods (plyometrics, ballistic training, etc.) are used, is the RFD significantly improved. Absolute strength declines during this period, but this is an acceptable (and temporary) trade off. However, if absolute strength is allowed to degrade too much, RFD will suffer. For this reason, many coaches alternate between maximum strength and speed strength phases during the competitive period.

Overcoming the Decelerative and Inhibitory Aspects of Traditional Weight Training
Constant resistance (the most popular form of strength training used by athletes) has one distinct disadvantage: deceleration. Using the bench press as an example, when your arms near full extension, the antagonists (lats, biceps, rhomboids, and medial traps) begin to contract in an effort to decelerate the bar before it leaves your hands, as a protective mechanism. This is contrary to your objective, which is to accelerate your arm. There are at least two ways to address this inherent disadvantage of constant and variable resistance training: strengthen the antagonists and stabilizers, and use ballistic training.

Strengthening the Antagonists and Stabilizers
For every muscle in the body, there is another muscle that is capable of opposing its force. This "pairing" mechanism is how we are able to move with precision of movement and speed. However, when one part of this pair becomes too strong in relation to the other, force output capability suffers.

Many athletes often reinforce this inequity every time they train, thinking they are respecting the principle of specificity by training only the prime movers (or "agonists"). An example would be a martial artist who reasons that since the quadriceps muscle extends the leg during kicking, the quadriceps should receive the brunt of the training focus. Soon, the hamstrings (which are the antagonists in kicking movements) become weak in proportion to the quads, and power output declines. The student understandably (but incorrectly) concludes that weight training "slows you down," because for him, it did.

Weak antagonists contract prematurely to oppose the prime movers, resulting in reduced movement speed. Stronger antagonists are less sensitive to this protective response- the body "knows" that they are strong enough to decelerate the limb at the last possible moment. As an observation, the lats and biceps of elite level boxers are always well developed.

Weak stabilizers also limit power output. Stabilizers are muscles which anchor or immobilize one part of the body, allowing another part (usually the limbs) to exert force. The most important stabilizers are those of the trunk- the abdominals and trunk extensors. If the motor cortex detects that it can't stabilize the force provided by the prime movers, it simply won't allow the prime mover to contract with full force.

Ballistic Training
In a recent article, William Kraemer, a professor at Penn State, used the term "ballistic training" to describe movements that are "accelerative, of high velocity, and with projection into free space." Such methods include plyometrics, modified Olympic lifting, jumping, throwing, and striking movements (such as punching a heavy bag or kicking a shield).Since ballistic methods lack a deceleration phase, they are much more coordination-specific for most athletes. Ballistic training is initiated relatively late in the training cycle, as it requires significant preparatory training with lighter resistances to

strengthen tendons and ligaments.

Finally, there is an irony when it comes to strength training for sport: the objective of strength training is NOT increased strength per se, but improved athletic performance. I would suggest that sports conditioning coaches keep this in mind as they design conditioning programs for their athletes.

(Note: This article was adapted from Special Topics in Martial Arts Conditioning, course text for the International Sports Sciences Association's Specialist in Martial Arts Conditioning (SMAC) certification program.

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